Scientists Confirm Robustness of Key Component in Ultra-High-Efficiency Solar Cell

NREL researchers develop a new tool that confirms the stability of the IMM solar cell's 1-eV metamorphic junction.

To test the robustness of NREL's inverted metamorphic multijunction (IMM) solar cell against dislocation-induced degradation, scientists developed a concentrated-illumination simulator that uses a laser to provide very high illumination intensities over long periods, coupled with a temperature-controlled sample stage. Using this capability, they completed an initial degradation test of a 1-eV junction (the metamorphic part of the IMM, which is subject to dislocations) and subjected the junction to 640 hours of illumination at an equivalent concentration of 670 suns and an elevated device temperature of 80°C.

The device showed minimal performance degradation as measured by open-circuit voltage. Furthermore, electron-beam-induced current imagery indicated no movement or increase in the number of dislocations. This is a significant confirmation of the robustness of the IMM structure, as required for low-cost power production using this device.

One of NREL's industry partners, RF Micro Devices, demonstrated III-V solar cells fabricated on its high-volume, 6 inch, GaAs wafer fabrication facilities. This is a major milestone toward demonstration of the full IMM structure.

These devices may soon replace the high-efficiency, lattice-matched multijunction III-V solar cells used in current concentrating PV systems such as the Amonix 7700 Solar Power Generator. NREL and Amonix won a 2010 R&D 100 Award for this technology. NREL and Emcore won a 2008 R&D 100 Award for the IMM solar cell.

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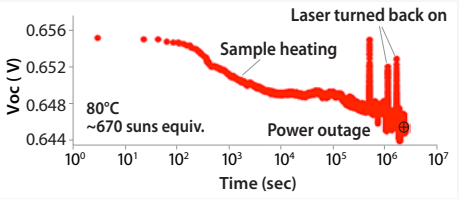
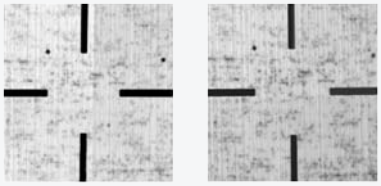
References: J.F. Geisz et al. "40.8% Efficient Inverted Triple-Junction Solar cell with Two Independently Metamorphic Junctions," *Appl. Phys. Lett.* **93**, 123505 (2008).

"RFMD Achieves Milestone in Commercialization of High-Performance Photovoltaic Cells," http://ir.rfmd.com/releasedetail.cfm?ReleaseID=554243. Accessed May 2, 2011.



Evolution of V_{oc} with time under illumination



Dislocations (black dots) before and after illumination

Key Research Results

Achievement

Scientists developed a concentrated-illumination simulator to test the robustness of the 1-eV junction in NREL's inverted metamorphic multijunction (IMM) solar cell against dislocation-induced degradation. This new tool uses a laser to provide very high illumination intensities over an extended period.

Key Result

NREL confirmed the robustness of the IMM structure, as required for low-cost power production. This is a major milestone toward commercial production of the IMM solar cell.

Potential Impact

The IMM solar cell is an excellent fit for concentrating PV systems serving the utility-scale solar energy market. The southwestern United States possesses a world-class, well-distributed, and nearly untapped solar energy resource.

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